

TOMBSTONE MUNICIPAL AIRPORT

Tombstone, Arizona

AIRPORT MASTER PLAN - 1999 4. DEVELOPMENT ALTERNATIVES

INTRODUCTION

This section contains a detailed comparative evaluation of several alternate major development options for the existing Tombstone Municipal Airport, including five alternate layouts for the ultimate runway(s).

The comparative evaluation was approached from a purely analytical point of view, comparing several areas of potential environmental, economic and developmental impact among the various alternates to reach an objective baseline for selection of the most desirable option. The methodology employed assumes that the best alternative action is the one which exhibits the least potential for adverse impact with the most frequency when compared to the other alternates.

Final site selection may actually be dependent upon impacts in one or two specific areas, such as relative cost of initial development, availability of land, the potential for expensive and time-consuming litigation, or simply a consensus of the local populace or airport authority.

THE "NO DEVELOPMENT" OPTION

The "No Development" or "Do Nothing" alternate infers maintenance of the existing airport facility as-is, with no major improvement investments being made. Although this represents the least costly out-of-pocket option, it would ultimately leave the City of Tombstone without a usable airport as the pavements and other facilities continue to degrade over time.

Adequate airport facilities are an important and undeniable factor in the consideration of site



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selection by new industry and commerce, and are a positive influence on tourism and the general economic health of the area. The economic impacts of an inadequate (or ultimately unusable) airport are difficult to accurately quantify, but will to some degree impact negatively on the business growth of the City.

To accept this option would adversely affect the airport's ability to safely accommodate the existing and future aviation demand. Presently, much of the City's air traffic uses other Cochise County airports because of the inadequate facilities at the Tombstone airport.

The recommendation of this study is that the "No Development" alternate be eliminated from consideration.

AIRPORT RELOCATION

Consideration of relocating the airport to another site would be a feasible option only if one or more of the following criteria were met:

- ▶ It was found that it would not be feasible from the standpoint of economic, engineering, or topographic constraints to construct the facilities necessary to accommodate the present or projected aviation demand at the present site, but the development could be undertaken at another available site.
- ▶ A potential for significant environmental impacts was identified that could not be reasonably mitigated if development were to occur at the present site, but could be avoided or mitigated at another available site.
- ▶ The present airport property is not located in an area under the jurisdiction of the airport owner, and appropriate land use controls cannot be implemented which would ensure the safe operation of the airport through the planning period while protecting the investment of public monies in airport infrastructure.
- ▶ The relocation would be a merging of two existing airports in close proximity to one another where overlapping services areas currently exist, if the other airport site could effectively accommodate the existing and future demand for both airports.

Since none of these criteria apply to the Tombstone Municipal Airport, the recommendation of this study is that the "Airport Relocation" alternate be eliminated from consideration.

DEVELOPMENT ALTERNATES

The five runway alternatives were developed such that each would be capable in the future of accommodating a reasonable range of ARC B-II aircraft (those with approach speeds of less than 121 knots and wingspans of less than 79 feet). All but one of the options includes the development of a 6,100' long ultimate primary runway. One of the alternates maintains the present runway length of 4,600'. It was assumed that the airport will remain a Visual Flight Rules (VFR) only facility, since instrument weather conditions occur only a very small percentage of the time, and the airport's proximity to mountainous terrain would make the development of an instrument approach difficult. The alternates were developed with the intent of utilizing existing airport land to the greatest extent possible, avoiding obvious significant environmental impacts, and minimizing construction and land acquisition costs.

The basic runway alignment and development criteria is as follows:

- ▶ Avoid disruption of existing airport terminal/parking area, as well as potential terminal/parking area expansion areas;
- ▶ Avoid relocation of existing U.S. Highway 80, to the west of the airfield, and Cowan Road, to the north;
- ▶ Avoid any known obstructions to air navigation in new approach surfaces, including vehicular clearances over U.S. Highway 80 and Cowan Road;
- ▶ Provide runway alignment(s) which will result in the greatest amount of wind coverage, based on examination of available record wind data and input from the local area pilots.
- ▶ Each layout depicts the minimum land requirements, interpreted according to current FAA guidelines. Land in the RPZ/Approach Surface areas that may be acquired as avigation easements instead of in fee is indicated as such. However, the Arizona State Land Department has indicated that their preferred method of acquisition would be fee purchase.

The five development alternates are illustrated at the at the end of this section, in Figures 4A through 4E. They are described as follows:

Alternate 1

Alternate 1 limits future development to the existing 4,600' long Runway 6-24. The initial phase of development consists of paving the present runway and maintaining its 60' width. A runup apron/turnaround would be constructed at the east end of the runway (the Runway 24 approach end). A 2.9 acre avigation

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easement would be required at for the Runway 6 approach and a 4.7 acre easement would be required for the Runway 24 approach. These will provide protection for the 20:1 approach surfaces over the visual Runway Protection Zone (RPZ) trapezoids.

In the future, the width of Runway 6-24 would be increased from 60' to 75'. No future land acquisitions would be required.

This option would ultimately accommodate a more limited range of aircraft than the other four alternates because of its shorter runway length. However, the critical aircraft determinations presented in Sections 2 and 3 indicate that the 4,600' length can accommodate a range of airplanes that may be acceptable when compared to the relative development costs and other factors.

Alternate 1 is illustrated in Figure 4A.

Alternate 2

Alternate 2 increases the ultimate length of Runway 6-24 from its present length of 4,600' to 6,100', a 1,500' increase. In the future, the pavement width would be increased from 60' to 75'. This would occur concurrent with the runway extension. 17.9 acres of land would need to be acquired in fee prior to extending the runway, and a new 7.4 acre aviation easement would be required for the Runway 24 approach.

An environmental assessment would be required, resulting in a "Finding of No Significant Impact" (FONSI), prior to extending the runway.

The initial phase of development is identical to Alternate 1.

This option would accommodate a broader range of larger and faster aircraft than Alternate 1 because of its longer runway.

Alternate 2 is illustrated in Figure 4B.

Alternate 3

Alternate 3 consists of constructing a new 6,100' x 75' primary Runway 2-20 in the ultimate term, while maintaining the present Runway 6-24 as a secondary (or crosswind) runway. The 2-20 alignment was selected in response to the local pilots' appraisal of the prevailing winds at the airport site. The location of the ultimate runway is based on minimizing earthwork, impacts to existing drainage, and providing the clearest approaches.

As with Alternates 1 and 2, the initial phase of development consists of paving Runway 6-24 (4,600' x 60'), and constructing a runup/turnaround apron at the east end. A 2.9 acre aviation easement would be required at for the Runway 6

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approach and a 4.7 acre easement would be required for the Runway 24 to provide protection for the 20:1 approach surfaces over the visual RPZ trapezoids.

The ultimate runway development would require the acquisition of 84.6 acres of land in fee, as well as 14.8 acres in aviation easements.

An environmental assessment would be required, resulting in a "Finding of No Significant Impact" (FONSI), prior to construction of the new runway.

This option would accommodate a broader range of larger and faster aircraft than Alternate 1 and would provide better wind coverage than a single-runway layout.

Alternate 3 is illustrated in Figure 4C.

Alternate 4

Alternate 4 consists of the phased construction of a new Runway 2-20 and abandonment of the present Runway 6-24.

The initial phase of development would be the construction of a 4,600' x 75' paved runway on the new 2-20 alignment, and closure of Runway 6-24. Acquisition of 84.6 acres of land in fee, as well as 14.8 acres in aviation easements (to accommodate the ultimate development) would be recommended as part of the initial development phase.

The ultimate development phase would consist of extending Runway 2-20 to 6,100' x 75'.

An environmental assessment would be required, resulting in a "Finding of No Significant Impact" (FONSI), prior to construction of the new runway, and also prior to its ultimate extension.

This option would accommodate a broader range of larger and faster aircraft because of its ultimate longer runway, and would provide better wind coverage than Alternate 1.

Alternate 4 is illustrated in Figure 4D.

Alternate 5

Runway 2-20 development in Alternate 5 is identical to Alternate 2. The present 4,600' x 60' runway would be paved in the initial phase and extended and widened to 6,100' x 75' in the ultimate term.

Alternate 5 also includes the development of a new graded secondary (crosswind) Runway 2-20 in the ultimate term. In accordance with FAA guidelines, the

length of this runway would be 80% of the primary runway length, or 4,900'.

For the initial phase of development, a 2.9 acre avigation easement would be required at for the Runway 6 approach and a 4.7 acre easement would be required for the Runway 24 to provide protection for the 20:1 approach surfaces over the visual RPZ trapezoids.

The ultimate Runway 2-20 development would require the acquisition of 62.5 acres of land in fee, as well as 14.8 acres in avigation easements.

An environmental assessment would be required, resulting in a "Finding of No Significant Impact" (FONSI), prior to construction of the new Runway 2-20 and extension of Runway 6-24.

This option would accommodate a broader range of larger and faster aircraft than Alternate 1, because of its longer runway, and would provide better wind coverage than the single-runway layouts.

Alternate 5 is illustrated in Figure 4E.

MATRIX
EVALUATION
METHODOLOGY

In order to form a basis for selection of the most desirable option for future airport development, an objective analysis of several key factors was undertaken. These factors represent the key impact categories associated with the type of development under study, and focus on safety, utility, and economic considerations.

In the analysis, each category is evaluated independently of the others and each development alternate is assigned an "Evaluation Matrix rating" which is representative of that alternate's comparison to the other options in that specific category. A summation of all Evaluation Matrix ratings for each alternate represents the general desirability of each alternate relative to the others.

The development alternate with the lowest total rating represents the option with the best combination of safety, environmental and economics related features.

In cases where all of the alternates were considered equal in a specific category, all alternates were assigned the same rating (the lowest ranking remaining '1'). When sequential ranking was not possible (for instance, if all but one alternate were found to be equal), the highest ranking of '5' was assigned to the worst-case option.

COMPARISON OF
DEVELOPMENT
COSTS

The relative costs for the development of each of the alternates were compared by considering only selected major elements of airside improvements (those relating to the runway environment) that would be necessary for each option. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included.

The costs were estimated by applying average unit prices for recently bid airfield improvement projects of similar scope and magnitude in the same general geographic area.

The Arizona State Land Department prefers that all State trust lands be acquired in fee, rather than easement or right-of-way. The FAA, however, will accept protection of portions of the RPZ and Approach Surfaces in aviation easements. In the estimates, the quantities of land are broken out as either "Fee Acquisition" areas or "Avigation Easement" areas, according to the FAA's probable minimum requirements. However, identical costs have been assumed for each of the areas to account for the State Land Department's requirements.

All costs include engineering and administration expenses. These were estimated as 20% of construction costs.

The relative costs for the initial and ultimate phases of development are presented in the following tables.

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ALTERNATE I

Estimated Development Costs - Selected Major Runway Improvements

| Development Item | Estimated Cost |
|--|----------------|
| <i>Short Term Development:</i> | |
| Acquire Avigation Easement areas (7.6 acres) | \$15,200 |
| Pave Runway 6-24 (4,600' X 60') | \$230,200 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Install MIRL System - Runway 6-24 (4,600') | \$84,200 |
| Total Cost of Initial Development Phase: | \$391,400 |
| <i>Ultimate Development:</i> | |
| Widen Runway 6-24 from 60' to 75' | \$401,900 |
| Construct Turnaround - Runway 6 | \$61,800 |
| Total Cost of Ultimate Development Phase: | \$463,700 |
| Total Estimated Costs for Development: | \$855,100 |

Costs are approximate estimates for construction of major runway-related improvements only. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included. Costs include engineering and administration expenses.

ALTERNATE 2
Estimated Development Costs - Selected Major Runway Improvements

| Development Item | Estimated Cost |
|--|--------------------|
| <i>Short Term Development:</i> | |
| Acquire Avigation Easement areas (7.6 acres) | \$15,200 |
| Pave Runway 6-24 (4,600' X 60') | \$230,200 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Install MIRL System - Runway 6-24 (4,600') | \$84,200 |
| Total Cost of Initial Development Phase: | \$391,400 |
| <i>Ultimate Development:</i> | |
| Fee Acquisitions for Runway Development (17.9 acres) | \$35,800 |
| Acquire Avigation Easement areas (7.4 acres) | \$14,800 |
| Widen Runway 6-24 from 60' to 75' | \$401,900 |
| Environmental Assessment | \$40,000 |
| Extend Runway 6-24 from 4,600' to 6'100' X 75' | \$302,700 |
| Extend MIRL | \$25,000 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Construct Turnaround - Runway 6 | \$61,800 |
| Total Cost of Ultimate Development Phase: | \$943,800 |
| Total Estimated Costs for Development: | \$1,335,200 |

Costs are approximate estimates for construction of major runway-related improvements only. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included.

Costs include engineering and administration expenses.

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ALTERNATE 3 Estimated Development Costs - Selected Major Runway Improvements

| Development Item | Estimated Cost |
|--|----------------|
| <i>Short Term Development:</i> | |
| Acquire Avigation Easement areas (7.6 acres) | \$15,200 |
| Pave Runway 6-24 (4,600' X 60') | \$230,200 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Install MIRL System - Runway 6-24 (4,600') | \$84,200 |
| Total Cost of Initial Development Phase: | \$391,400 |
| <i>Ultimate Development:</i> | |
| Environmental Assessment | \$50,000 |
| Fee Acquisitions for Runway Development (84.6 acres) | \$169,200 |
| Acquire Avigation Easement areas (14.8 acres) | \$29,600 |
| Construct New Runway 2-20 (6,100' X 75') | \$1,231,100 |
| Construct Turnaround - Runway 2 | \$61,800 |
| Construct Turnaround - Runway 20 | \$61,800 |
| Install MIRL System - Runway 2-20 (6,100') | \$83,200 |
| Construct Turnaround - Runway 6 | \$61,800 |
| Total Cost of Ultimate Development Phase: | \$1,748,500 |
| Total Estimated Costs for Development: | \$2,139,900 |

Costs are approximate estimates for construction of major runway-related improvements only. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included. Costs include engineering and administration expenses.

ALTERNATE 4
Estimated Development Costs - Selected Major Runway Improvements

| Development Item | Estimated Cost |
|--|--------------------|
| <i>Short Term Development:</i> | |
| Environmental Assessment | \$50,000 |
| Acquire Avigation Easement areas (14.8 acres) | \$29,600 |
| Fee Acquisitions for Runway Development (84.6 acres) | \$169,200 |
| Construct Phase 1 Runway 2-20 (4,600' X 75') | \$928,400 |
| Construct Turnaround - Runway 2 | \$61,800 |
| Construct Turnaround - Runway 20 | \$61,800 |
| Install MIRL System - Runway 2-20 (4,600') | \$84,200 |
| Total Cost of Initial Development Phase: | \$1,385,000 |
| <i>Ultimate Development:</i> | |
| Environmental Assessment | \$40,000 |
| Extend Runway 2-20 from 4,600' to 6,100' X 75' | \$302,700 |
| Construct Turnaround - Runway 20 | \$61,800 |
| Extend MIRL System | \$25,000 |
| Total Cost of Ultimate Development Phase: | \$429,500 |
| Total Estimated Costs for Development: | \$1,814,500 |

Costs are approximate estimates for construction of major runway-related improvements only. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included. Costs include engineering and administration expenses.

ALTERNATE 5
Estimated Development Costs - Selected Major Runway Improvements

| Development Item | Estimated Cost |
|--|--------------------|
| <i>Short Term Development:</i> | |
| Acquire Avigation Easement areas (7.6 acres) | \$15,200 |
| Pave Runway 6-24 (4,600' X 60') | \$230,200 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Install MIRL System - Runway 6-24 (4,600') | \$84,200 |
| Total Cost of Initial Development Phase: | \$391,400 |
| <i>Ultimate Development:</i> | |
| Fee Acquisitions for Runway Development (80.4 acres) | \$160,800 |
| Acquire Avigation Easement areas (22.2 acres) | \$44,400 |
| Widen Runway 6-24 from 60' to 75' | \$401,900 |
| Environmental Assessment | \$50,000 |
| Extend Runway 6-24 from 4,600' to 6'100' X 75' | \$302,700 |
| Extend MIRL - Runway 6-24 | \$25,000 |
| Construct Turnaround - Runway 24 | \$61,800 |
| Construct Turnaround - Runway 6 | \$61,800 |
| Construct Graded Runway 2-20 (4,900' X 120') | \$472,000 |
| Total Cost of Ultimate Development Phase: | \$1,580,400 |
| Total Estimated Costs for Development: | \$1,971,800 |

Costs are approximate estimates for construction of major runway-related improvements only. Terminal area improvements, access road improvements, buildings (except electrical vault), and airport visual aids that would be common to any of the alternates are not included. Costs include engineering and administration expenses.

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Summary

Separate rankings for the initial, ultimate, and total costs of development for each of the five alternates have been applied. The ranking is as follows:

Approximate INITIAL Development Costs Five Development Alternates

| | <u>Approximate Cost</u> | <u>Ranking</u> |
|---------------|-------------------------|----------------|
| ALTERNATE 1 : | \$ 391,400 | 1 |
| ALTERNATE 2 : | \$ 391,400 | 1 |
| ALTERNATE 3 : | \$ 391,400 | 1 |
| ALTERNATE 4 : | \$ 1,385,000 | 5 |
| ALTERNATE 5 : | \$ 391,400 | 1 |

Approximate ULTIMATE Development Costs Five Development Alternates

| | <u>Approximate Cost</u> | <u>Ranking</u> |
|---------------|-------------------------|----------------|
| ALTERNATE 1 : | \$ 463,700 | 2 |
| ALTERNATE 2 : | \$ 1,335,200 | 3 |
| ALTERNATE 3 : | \$ 2,139,900 | 5 |
| ALTERNATE 4 : | \$ 429,500 | 1 |
| ALTERNATE 5 : | \$ 1,580,400 | 4 |

Approximate TOTAL Development Costs Five Development Alternates

| | <u>Approximate Cost</u> | <u>Ranking</u> |
|---------------|-------------------------|----------------|
| ALTERNATE 1 : | \$ 855,100 | 1 |
| ALTERNATE 2 : | \$ 1,335,200 | 2 |
| ALTERNATE 3 : | \$ 2,139,900 | 5 |
| ALTERNATE 4 : | \$ 1,814,500 | 3 |
| ALTERNATE 5 : | \$ 1,971,800 | 4 |

The rankings above suggest that Alternate 1, 2, 3 or 5 would be the most desirable in terms of initial ultimate development costs (the initial development scope is identical for these four alternates). Initial expenditures for Alternate 4 would be about 3½ times that of the other alternates, because of the need to develop a completely new runway instead of improving the existing runway.

Alternate 4 would be the least expensive in terms of additional ultimate development costs, followed closely by Alternate 1.

In terms of the total estimated costs for development (initial plus ultimate), Alternate 1 is the least expensive followed by Alternate 2, which is about 1½ times as expensive.

It is important to note that the recommended initial improvements to the existing Runway 6-24 could be undertaken with selection of any of the alternates except Alternate 4.

UTILIZATION OF PAST INVESTMENT OF PUBLIC MONEY

Four out of five of the development alternates would utilize the existing Runway 6-24 as the basis for expansion. Alternate 4 would not, since it calls for abandonment of the existing runway and development of a single new Runway 2-20.

The existing Runway 6-24 was developed with funding participation by ADOT and the City of Tombstone and represents a valuable asset. Utilization of this past investment contributes to the total economy of the development of the airport. This has been recognized by assigning an Evaluation Matrix rating of 1 to Alternates 1, 2, 3 and 5, and a rating of 5 to Alternate 4.

TERRAIN AVOIDANCE AND POTENTIAL OBSTRUCTIONS TO AIR NAVIGATION

The standards for determining obstructions to air navigation are found in FAR Part 77. In Subpart 77.23 of the regulations, obstructions are defined as an object (including a mobile object) which is greater than...

... a height of 500 feet above ground level at the site of the object; or

... a height that is 200 feet above ground level or above the established airport elevation (whichever is higher) within three nautical miles of the reference point of an airport which has a runway more than 3,200 feet in length. That height increases in the proportion of 100 feet for each additional nautical mile from the airport, up to a maximum of 500 feet.

An examination of the area surrounding the airport indicates that there are no existing objects that would be classified as obstructions under this criteria.

Part 77 also establishes airport "imaginary surfaces", which are geometrically based upon the actual physical layout of the runways and the category of the airport's ultimate use. An object is defined as an obstruction if it would penetrate any of these imaginary surfaces.

By definition, the imaginary surfaces become increasingly critical with respect to height limitations as they become nearer to the runway surfaces, finally allowing an object height of zero within 200 feet of the runway ends.

Potential Obstructions to Approach Surfaces

An examination of the FAA Approach Surfaces for each of the alternatives was undertaken to determine the existence of any potential obstructions within the most critical segment of approach and departure. For a VFR-only airport serving ARC A-I through B-II aircraft with takeoff weights of not more than 12,500 pounds, the Approach Surface trapezoid's dimensions are 250' (at the end closest to the runway threshold) x 5,000' (in length) x 1,250' with a 20:1 approach slope.

Initial layout of the various runway development alternates was undertaken such that adequate clearance over U.S. Highway 80 and Cowan Road would be maintained in all cases, therefore no vehicular clearance conflicts are noted. No other apparent Approach Surface penetrations were found to occur, and each of the alternates was assumed to be equal in this category. Each was assigned an Evaluation Matrix rating of 1.

Potential Terrain Penetrations of the Horizontal and Conical Surfaces

Two other critical FAR Part 77 surfaces are the Horizontal Surface and the Conical Surface.

For a VFR-only airport serving ARC A-I through B-II aircraft with takeoff weights of not more than 12,500 pounds, the Horizontal Surface is constructed by swinging arcs of 5,000' radius from a point 200' out from each runway threshold and connecting the arcs with tangent lines. The Horizontal Surface's elevation is 150' above the "established airport elevation", which is the highest point on any active runway. The Conical Surface extends for 4,000' beyond the outer limits of the Horizontal Surface, at a slope of 20:1.

An examination of the area surrounding the airport site indicates that there are several instances where high terrain might penetrate these surfaces.

Each of the five alternates was evaluated in terms of the number of areas of penetration of the Horizontal or Conical Surface by terrain. The results of the evaluations for each of the alternates are illustrated in Figures 4G through 4J at

the end of this section.

Summary

The rankings suggest that the alternates are quite similar with regard to FAR Part 77 penetrations, with extension of Runway 6-24 being the determining factor (Alternates 2 and 5 result in an additional area of terrain penetration, the significance of which is arguable).

The rankings were assigned as follows:

Penetrations of FAR Part 77 20:1 Approach Surfaces Five Development Alternates

| | <u>Ranking</u> |
|---------------------------|----------------|
| ALTERNATE 1 (none): | 1 |
| ALTERNATE 2 (none): | 1 |
| ALTERNATE 3 (none): | 1 |
| ALTERNATE 4 (none): | 1 |
| ALTERNATE 5 (none): | 1 |

Number of Areas of Terrain Penetration of FAR Part 77 Horizontal and Conical Surfaces Five Development Alternates

| | <u>Number</u> | <u>Ranking</u> |
|--------------------|---------------|----------------|
| ALTERNATE 1: | 3 | 1 |
| ALTERNATE 2: | 4 | 5 |
| ALTERNATE 3: | 3 | 1 |
| ALTERNATE 4: | 3 | 1 |
| ALTERNATE 5: | 4 | 5 |

POTENTIAL FOR
ENVIRONMENTAL
IMPACTS

Any major development project may have the potential for impacts to the environment. These impacts may include disruption of existing wildlife habitat and desert plant species, air and water quality issues, disruption of established communities, increased noise exposure, or temporary construction impacts from dust, noise and erosion.

In general, a larger scale project will have the potential for greater impacts to the environment. For instance, development of a new mile-long runway will have the potential for greater impact than a much smaller project such as a runway extension of several hundred feet.

For the purposes of this alternatives analysis, the amount of land acquisition that would be required for each alternate was used to represent the relative potential for environmental impacts. Greater amounts of land acquisition infer a larger scope of construction throughout the planning period and greater potential for adverse impacts to the environment.

Each of the alternates has been ranked accordingly, as follows:

Relative Land Acquisition Areas
Representing Potential for Environmental Impacts
Five Development Alternates

| | <u>Area*</u> | <u>Ranking</u> |
|--------------------|--------------|----------------|
| ALTERNATE 1: | 7.6 | 1 |
| ALTERNATE 2: | 32.9 | 2 |
| ALTERNATE 3: | 107.0 | 5 |
| ALTERNATE 4: | 99.4 | 3 |
| ALTERNATE 5: | 102.6 | 4 |

** Indicates the approximate area of fee plus easement acquisitions recommended, expressed in acres.*

WIND COVERAGE

Since crosswinds can be a major contributing factor in light aircraft accidents, the percentage of time that crosswind components are below an acceptable velocity may be used as an indicator of the relative usefulness and safety of any set of runway alignments.

In order to facilitate a comparison between the five development alternates, effective wind coverage was computed for both the primary runway alignment and for total composite coverage when there are two runways (composite coverage for a single runway layout is the same as the primary runway's coverage). 13 knot coverage was used in all cases in order to reflect the required ultimate ARC B-II design criteria.

The available wind data for the Kendall Hydrologic Field Site in Tombstone, as presented in Section 3 was used for this purpose.

A third rating has been included in the matrix evaluation. Local pilots have suggested that an alignment of about 2-20 is desirable when winds are at higher velocities. Therefore, each alternate that includes development of Runway 2-20 was assigned an Evaluation Matrix rating of 1 (Alternates 3, 4 and 5). Those that do not (Alternates 1 and 2) were assigned a rating of 5.

The tables below and on the following page are tabulations of the results of the wind coverage analyses:

Relative Wind Coverage (13 knot ARC B-II)
Primary Runway
Five Development Alternates

| | <u>Coverage</u> | <u>Ranking</u> |
|--------------------------------------|-----------------|----------------|
| ALTERNATE 1 (Runway 6-24): | 95.19% | 1 |
| ALTERNATE 2 (Runway 6-24): | 95.19% | 1 |
| ALTERNATE 3 (Runway 2-20): | 92.30% | 5 |
| ALTERNATE 4 (Runway 2-20): | 92.30% | 5 |
| ALTERNATE 5 (Runway 6-24): | 95.19% | 1 |

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Relative Wind Coverage (13 knot ARC B-II) Composite Coverage (All Planned Runways) Five Development Alternates

| | <u>Coverage</u> | <u>Ranking</u> |
|-------------------------------------|-----------------|----------------|
| ALTERNATE 1 (Rwy 6-24): | 95.19% | 2 |
| ALTERNATE 2 (Rwy 6-24): | 95.19% | 2 |
| ALTERNATE 3 (Rwy 6-24 + 2-20): | 96.49% | 1 |
| ALTERNATE 4 (Rwy 2-20): | 92.30% | 5 |
| ALTERNATE 5 (Rwy 6-24 + 2-20): | 96.49% | 1 |

Local Preference Regarding Runway Alignment for Known Prevailing High Winds at Airport Site Five Development Alternates

| | <u>Ranking</u> |
|--------------------|----------------|
| ALTERNATE 1: | 5 |
| ALTERNATE 2: | 5 |
| ALTERNATE 3: | 1 |
| ALTERNATE 4: | 1 |
| ALTERNATE 5: | 1 |

SUMMARY OF MATRIX EVALUATION

The following is a composite summary of the results of the comparative evaluation for each of the elements described above.

The total ratings achieved by each alternative in the analysis have been combined to reach a final composite evaluation rating, the lowest of which is the lowest ordinal ranking and presumably the best development option.

INITIAL EVALUATION MATRIX
Five Development Alternatives - Tombstone Municipal Airport

| | ALT 1 | ALT 2 | ALT 3 | ALT 4 | ALT 5 |
|--|------------------|------------------|------------------|------------------|------------------|
| Approximate Initial Development Costs | 1 | 1 | 1 | 5 | 1 |
| Approximate Ultimate Development Costs | 2 | 3 | 5 | 1 | 4 |
| Approximate Total Development Costs | 1 | 2 | 5 | 3 | 4 |
| Penetrations of FAR Part 77 20:1 Approach Surfaces | 1 | 1 | 1 | 1 | 1 |
| Number of Areas of Terrain Penetration of FAR Part 77 Horizontal and Conical Surfaces | 1 | 5 | 1 | 1 | 5 |
| Potential for Environmental Impacts - Area of Land Acquisitions | 1 | 2 | 5 | 3 | 4 |
| Utilization of Past Investment of Public Money | 1 | 1 | 1 | 5 | 1 |
| Composite Crosswind Coverage | 2 | 2 | 1 | 5 | 1 |
| Crosswind Coverage on Primary Runway | 1 | 1 | 5 | 5 | 1 |
| Local Preference Regarding Runway Alignment for Prevailing Winds | 5 | 5 | 1 | 1 | 1 |
| COMPOSITE RATING: | 16 | 23 | 26 | 30 | 23 |
| Ordinal Ranking: | 1st | 2nd | 3rd | 4th | 2nd |

RECOMMENDED
DEVELOPMENT
ALTERNATE

The most favorably ranked option is Alternate 1, which is clearly more favorable in terms of development costs, as well as in its potential for impacts to the environment. This is true only because this option limits the length of the primary runway to 4,600'. The other four alternates include a 6,100' long primary runway which will accommodate a greater range of larger and/or faster aircraft.

Of the alternates that allow for runway expansion to serve a greater range of aircraft, Alternates 2, 3 and 5 include the Alternate 1 development as a part of their initial development phases. Alternate 4 does not, and is also the least favorably rated option with reference to its Composite Rating (30) and Ordinal Ranking (4th). Alternates 2 and 5 share an Ordinal Ranking of 2nd, with a Composite Rating of 23. Alternate 3 is ranked 3rd with a Composite Rating of 26.

The recommended development option is Alternate 5, since it includes short term development of the most favorably ranked option, Alternate 1. Although Alternates 2 and 5 were essentially equally rated, Alternate 5 includes a future crosswind landing strip, and Alternate 2 does not.

The Tombstone Planning Advisory Committee (PAC) approved the recommended development option (Alternate 5) on September 24, 1998. The balance of this Master Plan specifically addresses this selected development plan.

April 15, 1999

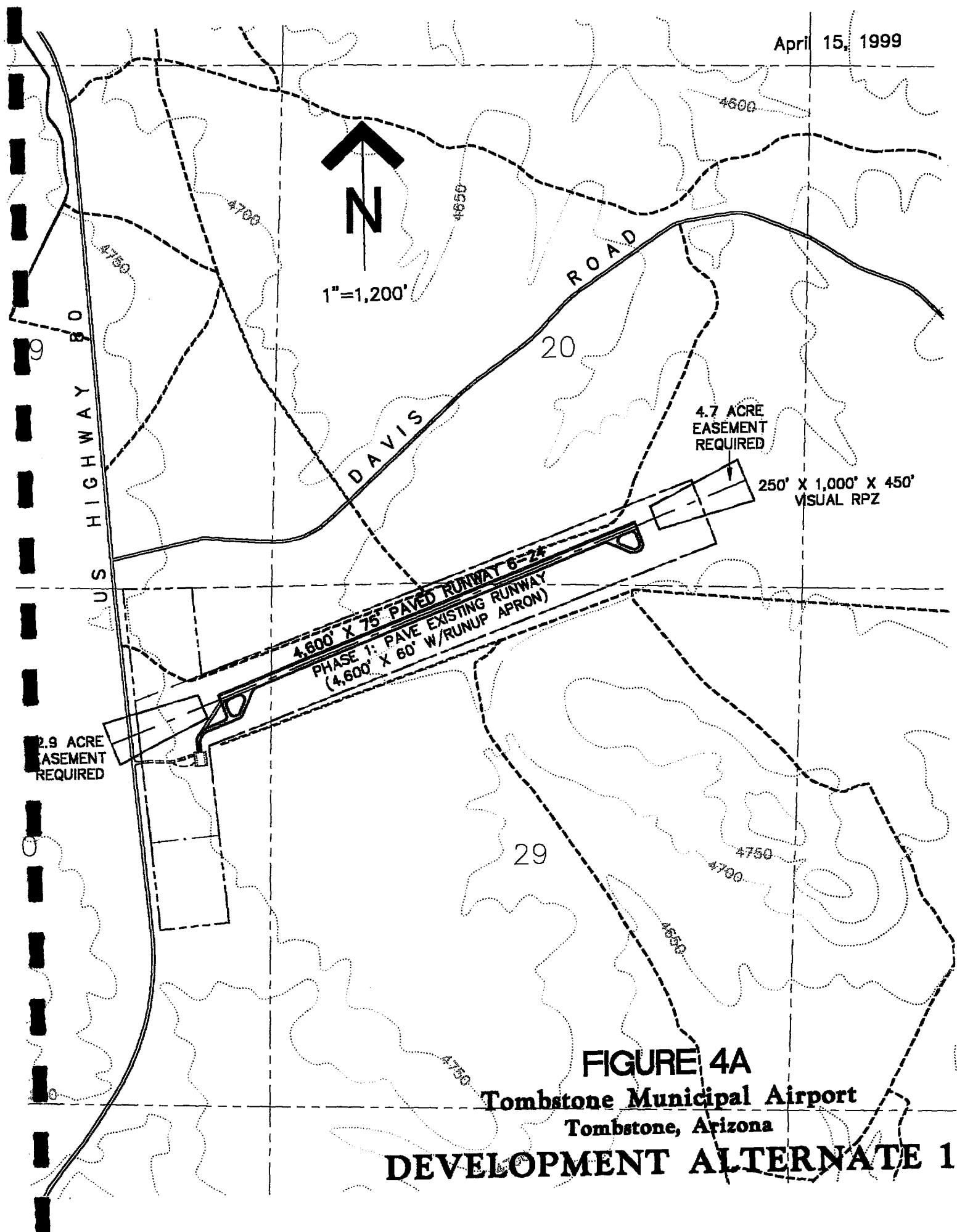


FIGURE 4A

**Tombstone Municipal Airport
Tombstone, Arizona**

DEVELOPMENT ALTERNATE 1

April 15, 1999

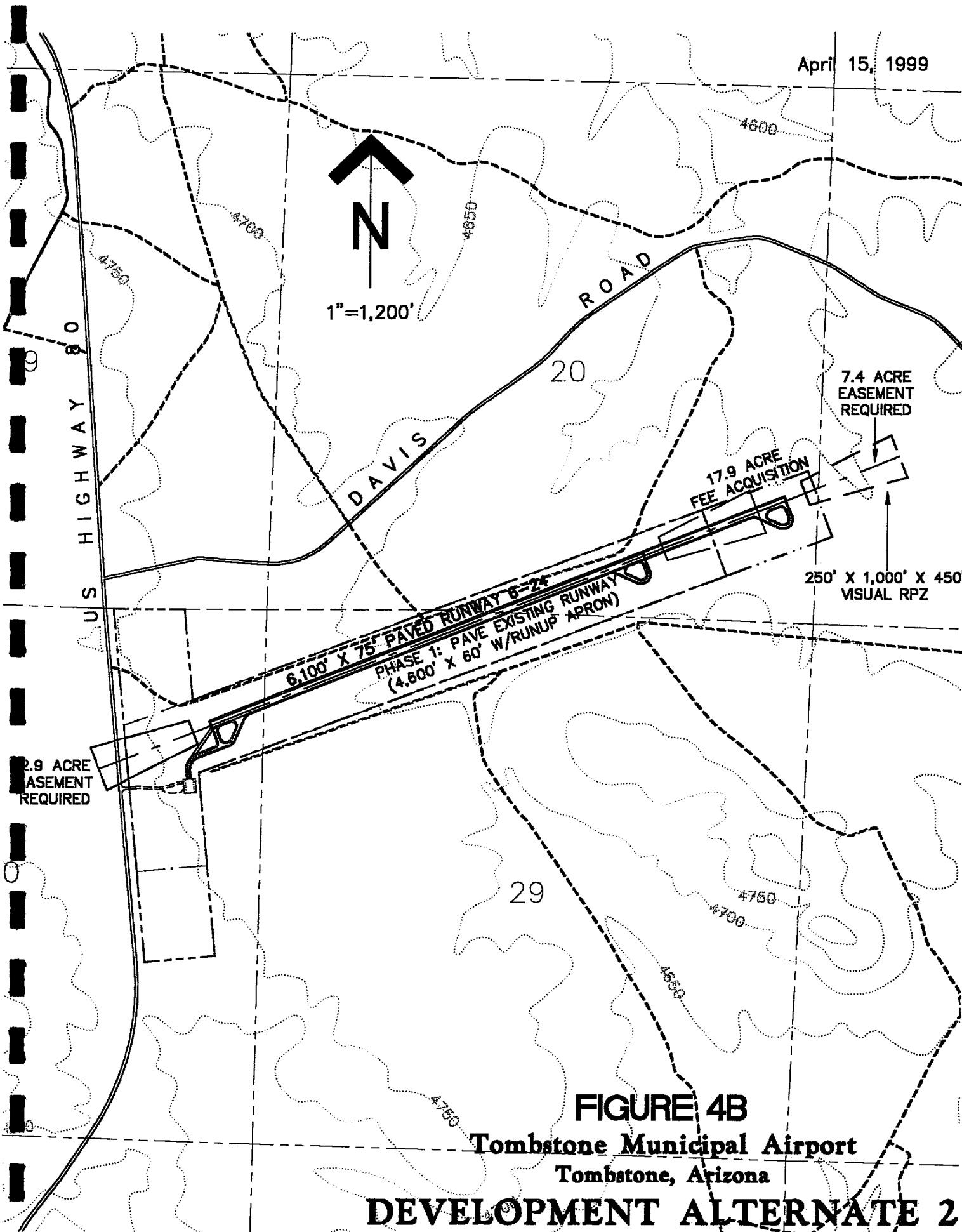


FIGURE 4B

**Tombstone Municipal Airport
Tombstone, Arizona**

DEVELOPMENT ALTERNATE 2

April 15, 1999

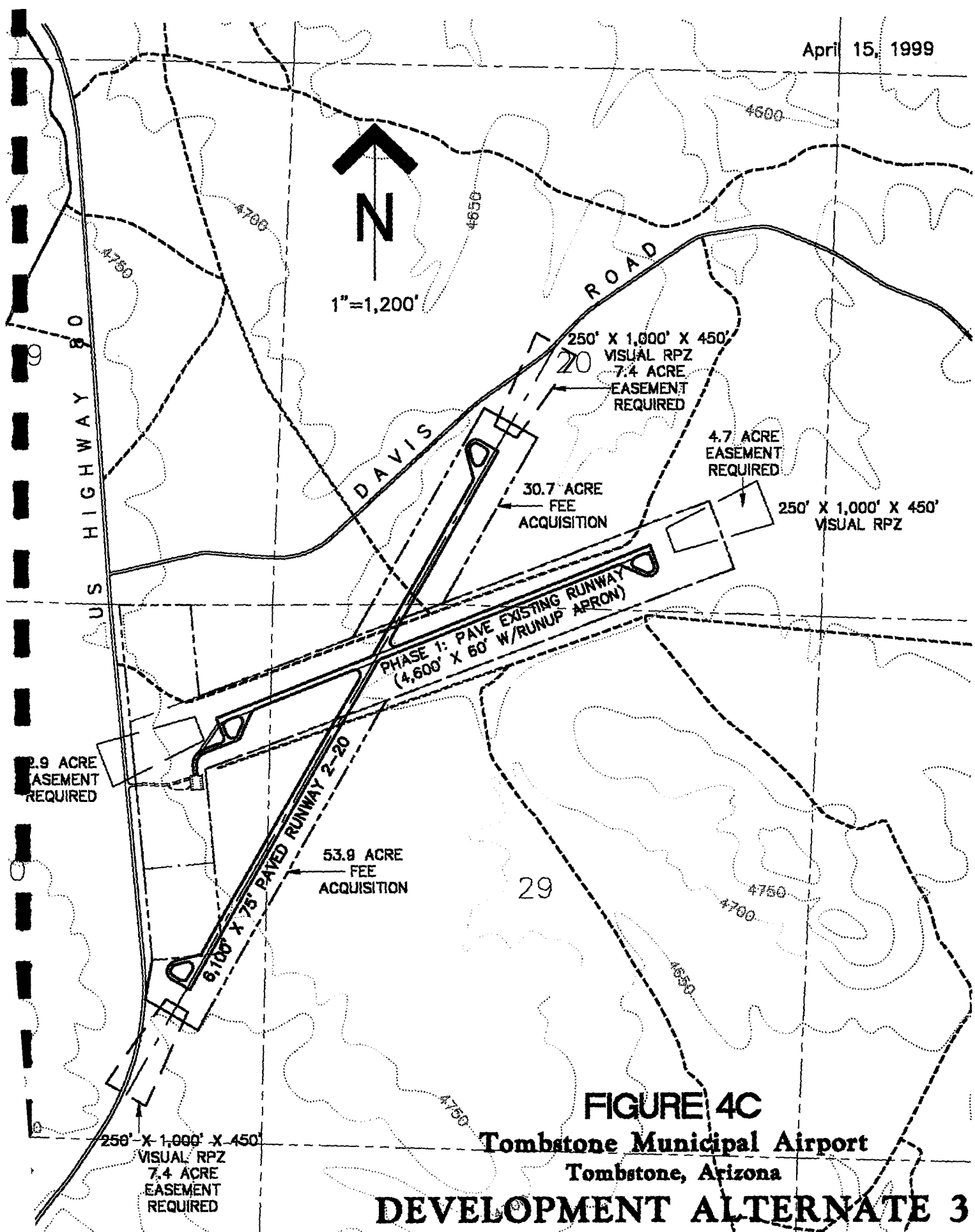


FIGURE 4C
Tombstone Municipal Airport
Tombstone, Arizona
DEVELOPMENT ALTERNATE 3

April 15, 1999

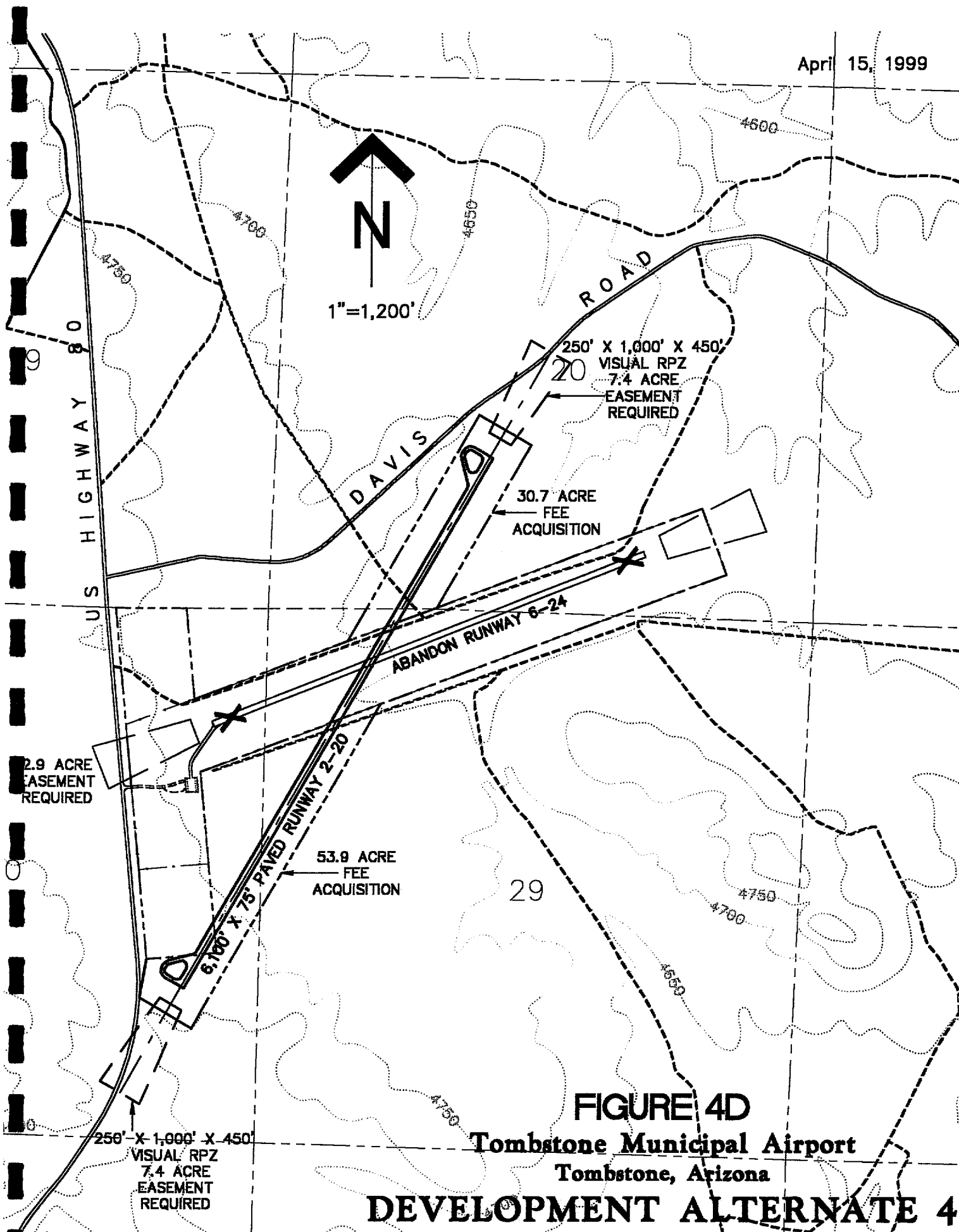


FIGURE 4D

**Tombstone Municipal Airport
Tombstone, Arizona**

DEVELOPMENT ALTERNATE 4

April 15, 1999

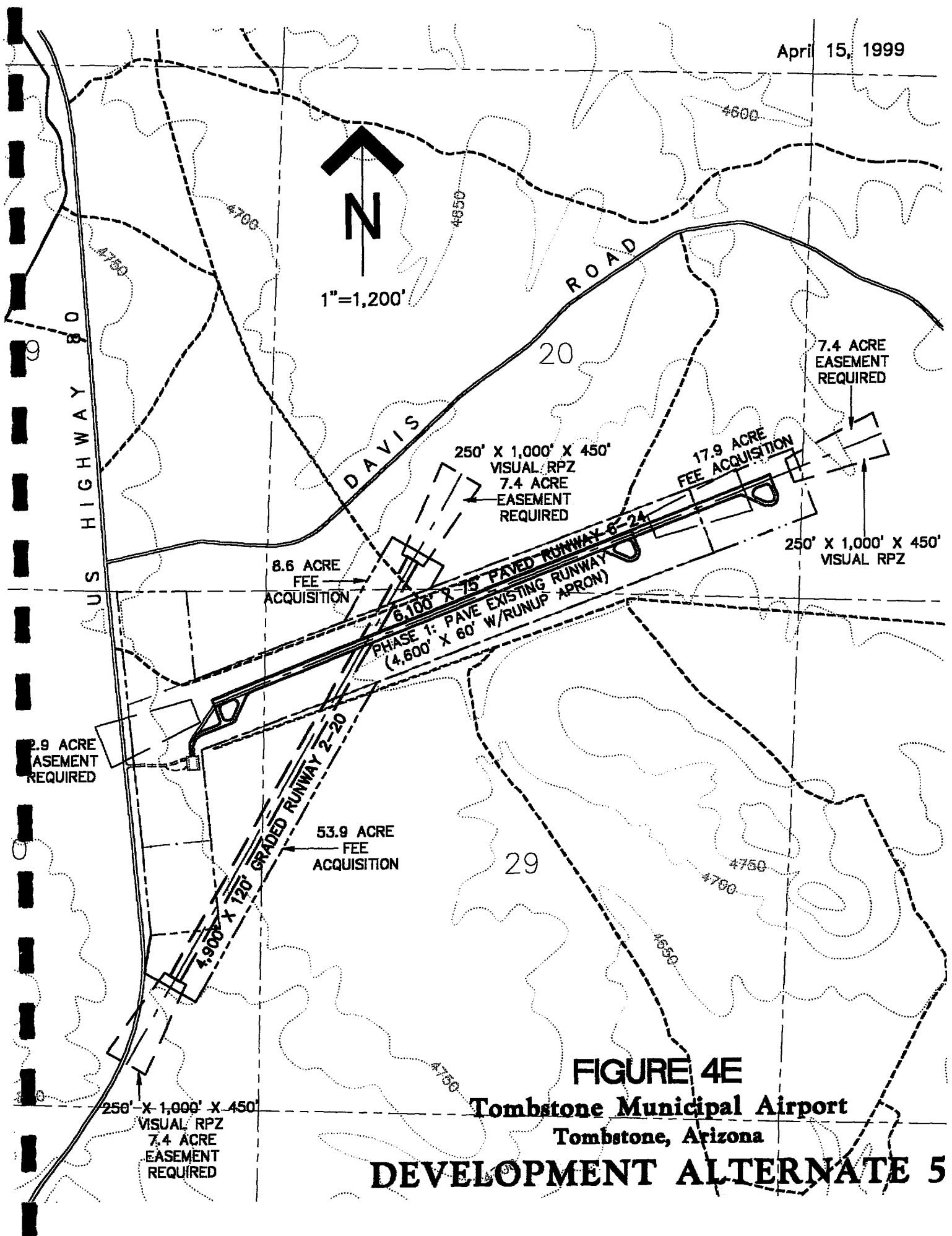


FIGURE 4E

Tombstone Municipal Airport

Tombstone, Arizona

DEVELOPMENT ALTERNATE 5

April 15, 1999

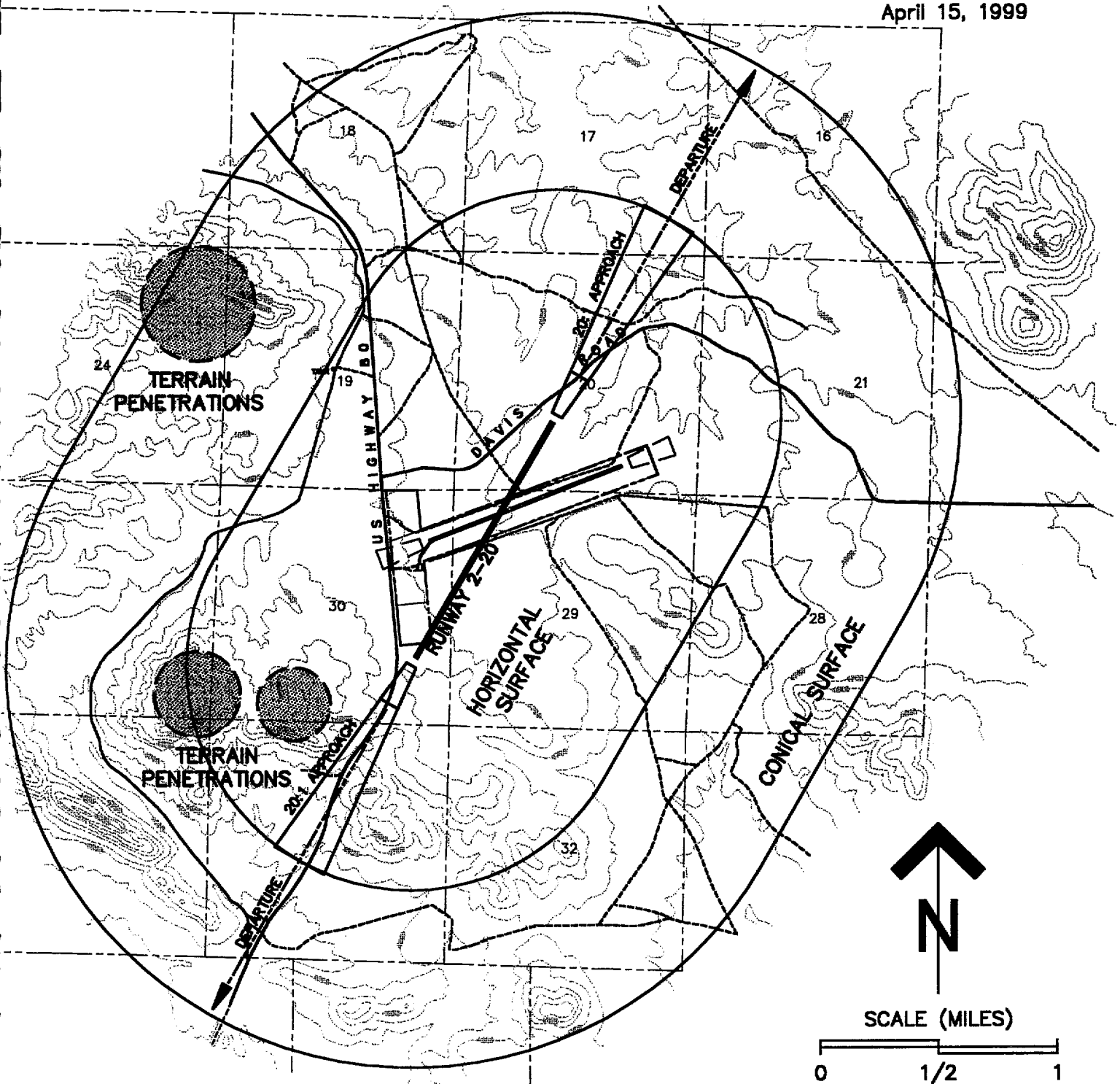


FIGURE 4I

**Tombstone Municipal Airport
Tombstone, Arizona**

**Terrain Penetrations of FAR Part 77 Surfaces
DEVELOPMENT ALTERNATE 4**

April 15, 1999

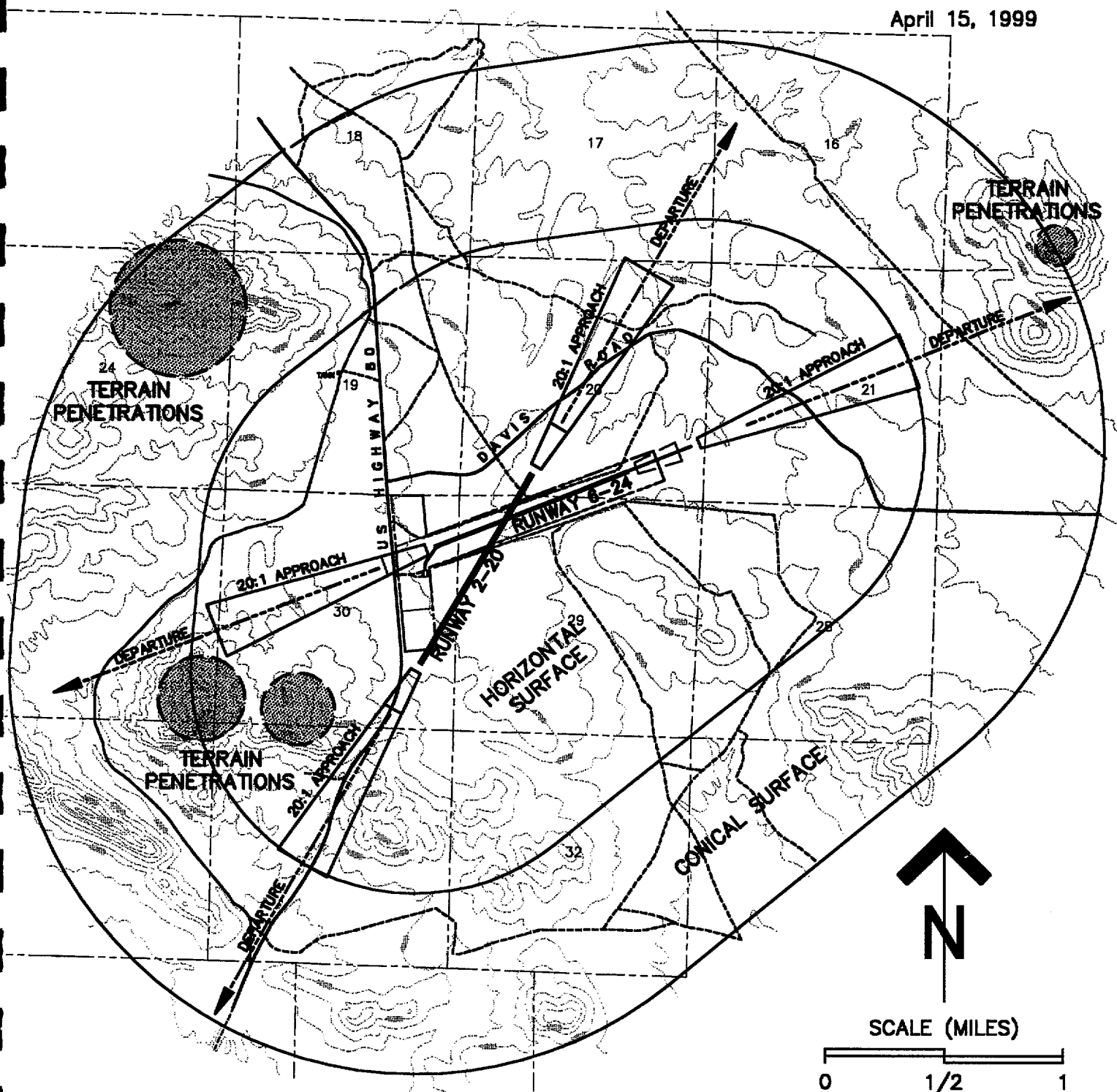


FIGURE 4J

**Tombstone Municipal Airport
Tombstone, Arizona**

**Terrain Penetrations of FAR Part 77 Surfaces
DEVELOPMENT ALTERNATE 5**